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MILK-FAT LAMB PRODUCTION PRACTICES FOR WESTERN KANSAS

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INTRODUCTION

Sheep production is one of the oldest and most important agricultural enterprises. The sheep industry produces two products, wool and meat.

In the early history of the United States sheep were raised almost exclusively for wool. Later on mutton became a more important market commodity for sheep industry. In more recent years lamb production has become the major source of income for sheepmen. Lamb has gained its prominence in the sheep industry because of the relatively greater demand for lambs as meat in comparison with the demand for wool.

The proportion of the sheep grower's income received from shorn wool sales decreased from an average of about 42 per cent of the total income to the sheep industry in 1910-1919, to an average of about 33 per cent during the early 1950's. The return in Kansas, a farm flock state, averages 20 to 23 per cent from wool production.

Conversely, income derived from sale of sheep and lambs for slaughter increased from the 1910-1919 average of 58 per cent of total income to sheep raisers to an average of 67 per cent in the early 1950's. In 1955 the income from the sale of sheep and lambs accounted for about 71 per cent of the total income from the sheep. The return in Kansas averaged 77 to 80 per cent in 1956, as mentioned by McAdams in 1957.

Kansas produces excellent wool and lambs as a result of its desirable climate, its native and temporary pastures, suitable

topography, and good terminal markets for fat lambs and wool.

In India the requirements of mutton and wool are, and apparently will continue to be, on the increase. Sheep, along with goats, contribute nearly 60 per cent of the total meat sold in the market. The annual yield of wool varies from three-fourths of a pound to four pounds per animal.

The purpose of this investigation was to determine the effects of preflushing and flushing the ewes, different lamb creep-feeding rations, and vaccinating the lambs on characteristics such as birth weight, gain and market age and weight, wool production, and weaning weight.

REVIEW OF LITERATURE

The Effect of Preflushing

Reducing the weight of the ewes before the flushing period is called preflushing, which is practiced to get the beneficial effect of the flushing.

Haepe (1899) of Cambridge University, found in survey that English flock masters were uniformly agreed that excessive fat rams and/or ewes were poorer breeders. Darlow and Hawkins (1933) and McKenzie and Phillips (1933) remarked that flushing is generally considered beneficial for ewes, because it not only results in higher fertility but also allows the ewes to breed earlier. Clark (1934) studied the effect of flushing on the number of eggs released from the ovary and found that the number was increased by flushing if the ewes were thin. In thin unflushed

ewes an average of one ovum was released during a given estrus, whereas in thin flushed ewes the average was 1.4 ova. For animals in high condition the averages were 1.5 for the flushed and 1.7 for the unflushed. From these results, Clark (1934) concluded that an improving nutritional level in thin ewes increased body weight and ovulation rate.

Rice and Andrews (1951) described that if the ewes were maintained on a high plane of nutrition, flushing does not have beneficial reproductive effect.

Menzies et al. (1963) divided the ewes into two groups, on the basis of age and number of lambs the previous year, and fed either of the two rations for 17 days. One group was fed a low-energy ration of two pounds alfalfa hay per ewe per day, and the other group received two pounds of alfalfa hay, one-fourth pound of sorghum grain, and three pounds of sorghum silage per ewe per day. In 1961 they found that the ewes receiving the low-energy ration lost weight during the preflushing period but made larger gains during the following flushing period and gave birth to three per cent more lambs. In 1962 they recorded that the ewes fed a low-energy ration during the preflushing period lost considerable weight, but the lambing performance was below that in 1961. The ewes fed a low-energy preflushing ration tended to lamb slightly earlier, but the other group of ewes had a 3.4 per cent larger lamb crop. McAdams and Coopersmith (1963) reported that the ewes given a low energy preflushing ration actually lose weight during that period, but this practice tends to shorten the lambing season and may increase the percentage

of lamb crop.

The Effect of Flushing

The practice of feeding ewes well a few weeks before the breeding season, so that they gain weight prior to and during the breeding season, is called flushing.

It is an accepted practice of many experienced sheepmen to flush ewes prior to and during breeding for the purpose of increasing lamb production by producing twins, triplets, earlier breeding, breeding more nearly at the same time, and the production of larger, healthier lambs.

The natural breeding season for most breeds of sheep is during the late summer and autumn. Ewes will usually begin to come in heat after the first cool nights, and the periods of heat recur approximately every 16 days until the ewes conceive. Kammlade and Kammlade (1955) mentioned that ewes can be flushed quite as well on pastures as by any other feeding practices. They have listed the benefits of flushing as earlier breeding, breeding more nearly at the same time, and the production of more and better lambs. They mentioned that 78 per cent of the twins were dropped during the first half of the lambing period, which may indicate that the best nourished ewes come in heat first and that they are most likely to shed two ova and to conceive; or it may mean that feed and pastures are better early in the season and thus have some effect on the number of ova available for fertilization.

Morrison (1959) believed that flushing ewes at breeding

time causes them to gain weight, produce twins, triplets, and to breed earlier and more nearly at the same time. He recommended good pastures previous to and during the breeding season, and in the absence of such pastures, one should provide the ewes with a small amount of grain at this time.

Marshall and Potts (1921) conducted an experiment with 302 purebred Southdown ewes, dividing them into 17 lots and feeding them at least one-half pound of grain per ewe per day. They found an average increase of 18.1 per cent in the number of lambs dropped as a result of flushing, but lambing dates varied considerably. Having all the lambs of about the same age is a great advantage in marketing and flock management. The data, reported by Marshall and Potts (1921), also showed a gradual rise in the proportion of twinning until the ewes were five and six years old. They recorded that ewes should gain at least seven pounds a head during the breeding season to obtain a maximum percentage of twins.

Miller et al. (1942), during his seven-year experiment with 434 sheep in various lots, found that ewes on pastures made gains during the breeding season--averaging 23.4 pounds per head--and produced a high percentage of lamb crop. He does not recommend flushing the ewes which are in good condition. Noot (1950) mentioned that if abundant pasture is not available, ewes should be fed with grain liberally at least two to three weeks before the breeding season begins, to get a larger lamb crop and to induce dropping of lambs at about the same time.

Darroch et al. (1950) conducted an experiment using 462

ewes and found that in prebreeding and breeding periods the thin ewes showed greater response to supplemental feeding than the fatter ewes, and flock fertility was increased by 10 and 9 per cent by feeding a supplement during the prebreeding and breeding periods, respectively. They also found that ewes in good condition produced 11 per cent more lambs at birth and at weaning than the thinner ewes. Gerring (1954) concluded that ewes must be flushed at least three weeks before the onset of breeding season to get the greatest possible increase in effective lambing percentage. If the period of flushing is shorter than three weeks, the lambing percentage will be correspondingly reduced. He also indicated that 130 per cent lamb crop can be confidently expected from five year old Romney ewes if they are flushed properly. Ahmed et al. (1955) found that ewes on the high level of feeding had a significantly higher ovulation rate, more and larger follicles, and had significantly larger uteri.

Dehoach and Williams (1957) recommended two pounds of good quality hay per head daily, and if succulent pasture is not available, the ewes may be fed one-half to three-fourths pound of grain per head daily and hay per choice. Whole oats or mixture of equal parts by weight of shelled corn and whole wheat is a satisfactory ration for flushing. They found that flushing helps to bring the ewes into heat so they all breed within a shorter period of time, getting lambs of uniform age and weight at market time.

Campbell et al. (1959) recorded that flushing range ewes during breeding slightly increased the percentage of lamb crop

in field trials. They studied 2,238 ewes, of which 1,428 served as controls, and 810 were fed an average of 26 pounds of cotton seed pellets for a 52-day period. Feeding began 21 days before the initial date of breeding and continued 31 days. They observed an increase of zero to 20 per cent in lamb crop, and the greatest response was with aged ewes in medium flesh.

Hulet et al. (1962) supplemented with 0.7 pound of oats for varying lengths of time before and during breeding to 1,200 Columbia and Targhee ewes, randomized within age and breeding pen into eight treatment groups. They conducted an identical experiment with a comparable group of ewes, also using one pound of alfalfa pellets as a supplement in lieu of oats, and found that oat supplementation had a significant effect ($p < .10$) in mature ewes on number of live lambs, pounds of live lambs born, and pounds of lambs weaned. A short flushing period 17 days immediately prior to breeding increased lamb production over the control. They recorded flushing an additional period of 17 days during breeding produced no further increase in production but increased the cost, and the third 17-day extension actually caused an apparent production decline from that obtained by the shorter flushing period.

Menzies et al. (1963) divided two groups of preflushed ewes in 1961 into six lots on the basis of age, number of lambs produced by each ewe the previous year, and preflushing treatment. Ewes were adjusted to flushing rations for three days and then fed the flushing rations for 40 days. Twelve Hampshire rams were turned in with the ewes at night. They recorded that ewes

grazing cereal crop pasture alone or supplemented with grain during the flushing period gained least but had larger lamb crop percentages because of more multiple births. They did not find marked differences in earliness of lambing between flushing rations. They also found that about 85 per cent of the ewes in all lots lambed within a 40-day period.

In 1962 Menzies et al. found that ewes flushed with cereal crop pasture, cereal crop pasture plus grain, or with buffalo grass pasture produced larger lamb crops than ewes fed other flushing rations as in past years. They found 90 per cent of the ewes lambed within a 30-day period, so the differences among lots in lambing dates were small.

Wickersham (1963) noted that flushing can increase the lamb crop provided it is done properly. "Ewes should be flushed two weeks before and one week after breeding." He recommended a good flushing ration of a mixture of half corn and half oats fed at the rate of three-fourths to one pound per ewe a day.

Williams (1954) found that flushing considerably increased twinning rates but not the rates of triplets, quadruplets, or quintuplets.

The Effect of Prelambing Rations on the Birth Weight of Lambs

It is a well-known fact that a pregnant ewe should be kept gaining steadily from the time of conception to lambing, and generally thrifty ewes produce strong lambs that are healthy and grow well.

During pregnancy a ewe must not only maintain herself but also should supply nourishment for the growing fetus and the production of her fleece.

Morrison (1959) mentioned that insufficient feed or an unbalanced ration, especially during the latter part of pregnancy, often results in weak lambs and a scanty flow of milk.

Reed (1927) found that a mixture of half corn and half oats made an excellent ration for pregnant ewes. He also mentioned that the pregnant ewe requires a relatively larger per cent of protein in her feed if her lamb is to be properly developed at birth; and if the ewes are fed only cheap, coarse roughages, it may have some bad effects on the unborn lambs.

Thompson and Fraser (1939) showed that lambs from well-fed ewes which had gained 50 pounds of weight during the pregnancy were about two pounds heavier at birth than those from poorly-fed ewes which had gained only eight pounds. They further noticed that lambs from ewes which were poorly fed during early pregnancy and well fed during the last month, so they gained 20 pounds, were just as large at birth as those from ewes well fed throughout the whole pregnancy.

Underwood et al. (1943) found that supplementing pregnant ewes with one-half pound each of wheat and linseed meal per head per day increased birth weight and growth rate of their lambs, but the superiority in birth weight and rate of growth was not sufficient enough to offset the increase in cost as was true for high levels of feeding. When pregnant ewes were supplemented at a lower level (one pound wheat per head per day), Underwood and

Sheir (1942) did not note any effect on birth weight, growth rate, or slaughter weight of lambs. However, they found that feeding at this level resulted in a significant reduction in losses of ewes due to pregnancy toxemia.

Thompson and Thompson (1948), while conducting an experiment with ewes on high and low planes of nutrition during the second half of the pregnancy, found that the ewes on the low plane of nutrition produced small and weak lambs, most of which died at birth or soon after, whereas the ewes on the high plane of nutrition produced vigorous lambs with few mortalities.

Wallace (1948a) studied the effect of extreme levels of diet upon ewes during early pregnancy and late pregnancy and concluded that the level of nutrition during the period which the gravid uterus is maximum growth is more important than the state of body reserved of the mother at that time. Again Wallace (1948b) found that the level of nutrition of the ewe during the first 91 days had little effect, whereas that during the last 53 days had a larger effect on the size of the fetus at birth, because during the later stage of pregnancy is when most of the fetal growth takes place.

Williams et al. (1950) reported that legume hay gave more satisfactory results than non-legume hay, as indicated by ewe body weight, lamb weight, and vigor of lambs at birth.

Weir and Albaugh (1954) found that the ewes well fed during the last six weeks of pregnancy, when the lambs are developing rapidly, will give birth to stronger lambs and produce more milk.

Dehoach and Williams (1957) found that thrifty ewes produce

strong and thrifty lambs and that the ewes should be well fed six weeks prior to lambing, starting with one-fourth pound grain per head and steadily increasing until the ewes are getting one pound per head daily to nourish the rapidly developing lamb.

The Effect of Creep-Feeding Lambs

The feeding of concentrates in creeps or small enclosures, to which the lambs have free excess but from which their mothers are excluded, has received the attention of research workers for at least half a century.

Some commercial lamb producers and most breeders of purebred sheep creep-feed their suckling lambs as a means of promoting faster gains and faster finish. Garrigus (1951) pointed out that "the normal peacetime lamb market has paid a premium for finished lambs weighing between 80 and 90 pounds." Creep-feeding helps more lambs to reach top market finish between those weights. Maximum growth and finish on purebred lambs appeals to buyers and wins more prizes in showing competition.

As early as 1895, John A. Craig tested corn meal, oats, and bran as feeds for lambs before and after they had been weaned and found that corn meal was decidedly better than oats or bran for feeding lambs before and after weaning in respect to the rate of gain, cost of gain, and feed efficiency. He also found that whole oats were superior to bran as a creep-feed. In 1897(a) he reported that the lot getting corn and peas gained slightly more and they ate more grain than the others. He found that the mixture of peas and corn was a ration that the lambs

relished, but previous to weaning these mixtures did not give as satisfactory results as the ground corn. However, on a ration such as ground corn alone there was more sickness among the lambs than when they received a mixed ration. Again in 1897(b), Craig found that ground corn gave the best results as far as cost of gain was concerned, and next to it ranked bran, while peas and oats were of equal value. Carlyle (1898) reported in an experiment with 24 Shropshire suckling lambs that corn meal surpassed whole oats, cracked peas, or bran in rate of gain and economy of gain, but the lambs required slightly more grain per pound of gain than the groups on whole oats or bran. In 1899 he tested coarsely cracked corn against cracked peas and reported similar gains and feed requirements for both lots and no apparent improvement in the consumption of cracked corn as compared with the finely ground corn fed in the previous experiments.

Harper (1934) at Purdue indicated no economic benefit from creep-feeding suckling lambs grazing on good pastures. He later reported that lambs on pasture with access to shelled corn in a creep made slightly larger gains than lambs on pasture only. Grissom and Newell (1952) reported that ordinarily "it does not pay to creep-feed lambs when plenty of good grass is available, and creep-fed lambs usually have fewer parasites." They recommended a ration consisting of cracked corn, crimped oats, and part protein meal. Weber (1930) recommended the practice of creep-feeding as one that would increase the rate of gain. He reported 10.9 per cent faster gains from lambs receiving twelve parts ground shelled corn, two parts bran, three parts linseed

oil meal and alfalfa hay, as compared with gains of similar lambs given two parts less linseed oil meal and two parts more corn. Weber and Joeffel (1932) reported that creep-fed lambs weaned at three months of age made satisfactory gains when continued on full feed for 28 days. Williams (1935) reported slightly faster gains on suckling lambs creep-fed up to a 40 pound live weight on a mixture of two parts cracked corn, two parts whole oats, two parts wheat bran, and one part linseed peacake than similar lambs creep-fed cracked corn only. Dyer and Weaver (1941) found that early spring lambs fed shelled corn in addition to their dam's milk and pasture made slightly faster gains than similar lambs fed no grains.

Garrigus (1951) compared yellow cracked shelled corn with a more complex mixture of six parts cracked corn, three parts crushed oats, and one part pea-sized linseed oil meal as creep-feeds for suckling lambs and found that cracked yellow shelled corn was the cheapest and best ration for creep-feeding suckling lambs out of heavy milking commercial ewes. McDonald (1950) found that equal parts of cracked corn and crushed oats made a good ration for creep-feeding lambs. He also recommended that a "little good hay" be placed in a rack close to the feeder, but he did not recommend creep-feeding for late lambs. Jordan and Gates (1961) recorded that both creep-feeding the lambs and grain feeding the lactating ewes increased lamb gains significantly. They also found that a complete pelleted creep-feed resulted in significantly faster gain.

Ross and Scles (1961) found that replacing the bran with

dehydrated alfalfa meal apparently reduced palatability to 144 per cent that of shelled corn. Increasing the dehydrated alfalfa meal content in creep-rations appeared to decrease palatability. In every case they found that pelleting creep rations almost doubled acceptability of mixtures.

Jordan (1961) found that creep-feeding lambs is necessary prior to weaning. To minimize the setback, the lambs should consume about three-fourths pound of creep-feed per lamb daily prior to weaning. Jordan and Wedin (1961) commented that the market price for spring lambs often reaches its peak during late May and early June, which encourages an increasing number of sheepmen to creep-feed their lambs.

Lewis (1964), Bennion (1940), Miller (1939), and Weir and Albaugh (1954) recommended creep-feeding to twin lambs for fast gain and the production of a uniform group of lambs and earlier weaning.

The Effect of Vaccination (Enterotoxemia) on Lamb Weight Gain

Gill (1937) was the first to study the disease in lambs to which he gave the name "Pulpy Kidney" in 1927. The absorbtion of the toxin Clostridium Welchia type "D" through the small intestine is believed to be the cause. Milk Colic, Enterotoxemia, Pulpy Kidney, Overeating Disease--all these elements are being recognized as the same. Sheep of all ages are susceptible, particularly those doing best on their dam's milk, lush pastures, or grains. Kittich *et al*. (1956) mentioned that enterotoxemia

may be caused by several types of clostridium perfringeus and during the spring. When sheep are placed on green pasture, after dry winter feeding, the causative agent is usually Cl. Welchia type "C". In late spring when the ration is high in carbohydrate, Cl. Welchia type "D" is commonly found. Immunization of sheep with anaculture produced solid immunization for three months. American Veterinary Medical Association Journal (1958) mentioned that "the disease can be reproduced consistently if the ration is changed suddenly and large quantities of rich feeds such as wheat are eaten before the culture is introduced. The disease may be prevented by avoiding sudden changes of ration, preventing sheep from overeating, and by vaccination." Bailey (1963) found mass outbreaks at lambing time or in feed lots where animals were being pushed for fast gain. He recommended vaccination as the most effective treatment, which takes about ten days for immunity to develop. Percival et al. (1954) found that vaccination of sheep against enterotoxemia with alum-precipitated formalized vaccine constantly produced local reaction resulting in decreases in market grade. Cox and Erhart (1950) kept one lot of lambs on wheat pasture only and the additional lots supplemented with sodium bicarbonate, mineral mixture, or vaccinated against enterotoxemia. From their tests, no evidence was found that vaccinating lambs on wheat pasture prevented losses from overeating disease. Bell and Erhart (1951) also found no losses from overeating diseases in another similar experiment; therefore, they could not find the efficiency of either vaccination or sodium

bicarbonate. In 1953 they vaccinated one-half of the lambs in all of the lots against overeating disease and found that the lambs vaccinated for overeating disease gained a little more than those unvaccinated.

Bell et al. (1953), after five years of research with 2,000 lambs using sodium bicarbonate as well as vaccine against enterotoxemia as preventive measures against death losses in feeding lambs, found no consistent advantages in providing either sodium bicarbonate in the diet or vaccinating the lambs. The effect of the two treatments upon feed consumption and rate of gain also was very slight and inconsistent. Menzies and Erhart (1964) found that vaccinated lambs gained .46 pound per head per day, and non-vaccinated lambs gained .45 pound per head per day.

MATERIALS AND METHODS

The data used in this analysis were the records from 1959 to 1962, which were collected by Mr. Evans E. Banbury, Superintendent at the Colby Branch Station. These experiments were directed by Professor Carl S. Menzies. The experiments involved 351 fine wool ewes. In 1959 there were 151 ewes, and in 1960, 200 additional ewes were purchased. Purebred Hampshire rams were used.

Preflushing ewe weight; ewe weight at the start of flushing; ewe weight at the end of flushing; ewe fleece weight; lambing date (the number of days between the date the rams were turned in with the ewes and lambing date); birth weight of lambs;

type of birth (single, twins, or triplets); sex of lambs (raised as ram, wether, or ewe); market age of lambs; market weight of lambs; lamb's total gain; and difference in average gain between vaccinated and non-vaccinated lambs was the information collected on each ewe or lamb.

The ewe flock was handled in an early lambing program, with the breeding season starting the last of May and extending to September first. All lambs were sold as milk-fat lambs during spring and early summer.

Preflushing

Beginning in 1960 the ewes received a preflushing treatment. In 1960 there were 150 two-year-old ewes included in the preflushing treatments; in 1961 there were 347 two and three-year-old ewes; and in 1962, 326 three and four-year-old ewes. The ewes were divided into two groups on the basis of age and the number of lambs produced the previous year and fed either one or the other of two rations for a period of 17 days preceding the flushing period. One group was fed a low energy ration of two pounds of alfalfa hay per ewe per day, and the other group received a maintenance ration of two pounds of alfalfa hay, one-fourth pound of sorghum grain, and three pounds of sorghum silage per ewe per day.

Flushing

At the end of the 17th day of the preflushing test an equal number of ewes from each preflushing group was placed in each

flushing group and fed for 40 days after being adjusted to the flushing rations for three days. At night, rams were turned in pairs with the ewes 8 to 10 days after the ewes were put into flushing rations. Rams were rotated to a new group twice each week.

In 1959 the ewes in lot one received rye pasture and/or chopped green cereal crops. In addition to rye pasture, 131 pounds of chopped wheat forage and 12 pounds of silage were fed each ewe during the 40-day flushing period.

The ewes in lot two received a ration of three-fourths pound whole sorghum grain, one and one-fourth pounds alfalfa hay, and free choice sorghum silage (4.7 pounds average consumption per ewe per day). The ewes in the third group grazed an 80-acre pasture of very good buffalo grass.

Beginning in the spring of 1960 the ewes were divided into six groups. The ewes in the first group were fed three-fourths pound of whole wheat, one and one-fourth pounds of alfalfa hay, and free choice sorghum silage in dry lot. (Average daily ewe silage consumption was 5.6 pounds.)

The second group received three-fourths pound whole sorghum grain, one and one-fourth pounds of alfalfa hay, and free choice sorghum silage. (Average daily ewe silage consumption was 5.6 pounds per head per day in dry lot.)

The third group of ewes grazed a cereal crop pasture and received one-half pound of whole sorghum grain per head daily. The ewes in lot four were allowed to graze a cereal crop pasture and received no supplement feed.

Those in lot five grazed a buffalo grass pasture and each received one-half pound of whole sorghum grain each day, while the ewes in lot six grazed a buffalo grass pasture.

Ewe Prelambing Treatment

In 1959, 151 yearling ewes and in 1960, 350 ewes used in the flushing tests were divided into three groups for studying the effect of prelambing treatment for six weeks prior to lambing. The first group of ewes was grazed on good buffalo grass pasture and received one-fourth pound sorghum grain per ewe daily, while the ewes in the second group were grazed on lush rye pasture and one-fourth pound of sorghum grain per ewe daily. Ewes in the third group grazed a good buffalo grass pasture and were fed one-fourth pound of 41 per cent protein soybean oil meal pellets per ewe daily.

Lamb Creep-feeding

Ewes and lambs were divided into six lots according to prior ewe treatment, date of lambing, and type of lambing (single, twins, or triplets). A one-week adjustment period after the lamb's birth was allowed before ewes and lambs were placed in their respective lots. Lambs were docked and castrated during that week. Creep-rations were self-fed when the lambs were one week old, and the lambs were sent to market in periodic shipments as a sufficient number of lambs weighing at least 95 pounds each were available.

In 1959 the ewes and lambs were divided into three groups

for studying the effect of different rations. The first group of ewes and lambs were grazed on rye pasture, and the lambs had access to a creep-ration of whole sorghum grain and alfalfa hay. Ewes and lambs in the second group grazed rye pasture and no creep was provided to the lambs. Ewes in the third lot were fed a daily ration of one pound of whole sorghum grain, one to one and one-fourth pounds of alfalfa hay, and all the sorghum silage they would consume. The lambs also had access to a creep of whole sorghum grain and alfalfa hay.

One-half of the lambs in each group were given 3 cc. of enterotoxemia antitoxin containing a minimum of 4,500 antitoxin units when they were 10 to 48 days old. Bacterin was later given these same lambs when the youngest was two months old. Beginning with the 1960-61 lambs, the ewes and lambs were divided into six groups, and the ration fed to four groups of ewes (those in lots 1, 2, 5, and 6) consisted of sorghum silage, one pound of whole sorghum grain, and one and one-fourth pounds of alfalfa hay. The third group was on rye pasture when it was available and when not on rye, their ration was the same as lots 1, 2, 5, and 6. Ewes in the fourth group were fed sorghum silage, one pound of whole sorghum grain, and one and one-fourth pounds of dehydrated alfalfa hay (17 per cent protein with 100,000 units of vitamin A guaranteed per pound).

The six lamb creep-rations were, respectively, as follows: sorghum grain and alfalfa hay; rolled barley and pelleted alfalfa hay; sorghum grain and alfalfa hay; sorghum grain, dehydrated alfalfa pellets and alfalfa hay; same as lot four; and a

pelleted mixture of 45 per cent sorghum grain and 55 per cent alfalfa hay.

In 1962-63, one-half of the single male lambs in each lot were castrated and one-half left as ram lambs. Prior to 1961-62 all male lambs were castrated within the first week of life.

Correlative coefficients between each character and associated characters such as gain during the flushing period and earliness of lambing, gain during flushing and birth weight of lambs, birth weight of lambs and earliness of lambing, earliness of lambing and fleece weight of lambs were determined by analyzing the data using an IBM Data Processing Machine. The differences between lambs vaccinated for enterotoxemia and non-vaccinated lambs for market weights, and average daily gain to sale date, and differences due to ewe prelambing ration and lamb creep-rations were analyzed by the use of analysis of variance techniques.

RESULTS AND DISCUSSION

Effect of Preflushing on Weight Loss of the Ewes and Lambing Performance

Preflushing is a period preceding the flushing period in which the ewes are provided with low energy ration in an effort to cause them to lose weight so that they will be in a physiological condition more conducive to weight gaining during the flushing period. The objective of the flushing period is to increase the lamb crop percentage and to get earlier lambs. During the three years 1960-1962, ewes were placed in one or

the other of two treatment groups. The first group was placed on a low energy ration, whereas the second group was placed on a maintenance feeding regime.

The effects of the two planes of nutrition on ewe weight during the 17-day trial are shown in Table 1.

Table 1. Weight losses of ewes during the preflushing period 1960 to 1962.

Year	Preflushing ration	No. of ewes	Av. preflushing loss per ewe (lbs.)*
1960	Low energy	75	22.24
	Maintenance	75	17.65
1961	Low energy	176	11.49
	Maintenance	171	6.48
1962	Low energy	161	21.54
	Maintenance	165	10.27

*Weight loss includes fleece weight which averaged 10 pounds.

Possible explanation as to why the fat ewes tended to produce a smaller lamb crop is that from a physiological point of view, a reduction in the production of the sex hormones is followed by increased fat deposition, and the ovaries in fat ewes may become so infiltrated with fat as to hinder the development of follicles, with a consequent irregularity or cessation of estrus which results in delay or failure in breeding.

Statistically significant differences were observed during all years in the weight loss for ewes ($p < .05$) which received a low energy ration of two pounds of alfalfa hay per ewe per day when compared with the ewes on maintenance ration consisting of

Table 2. Lambing performance of the ewes fed two different preflushing rations (1960).

Ration	Single birth	Twins	Total lambs	Total ewes	Lambing per cent
Low energy	50	48	98	75	130.67
Maintenance	54	38	92	75	122.67
Total	104	86	190	150	126.67

two pounds alfalfa hay, one-fourth pound whole sorghum grain, and three pounds sorghum silage.

Table 3. Lambing performance of the ewes fed two different preflushing rations (1961).

Ration	Single birth	Twins	Total lambs	Total ewes	Lambing per cent
Low energy	119	84	203	176	115.34
Maintenance	123	64	187	171	109.35
Total	242	148	390	347	112.39

Tables 2 and 3 indicate that ewes receiving a low energy ration for the years 1960 and 1961 had 8 and 5.99 per cent more lambs, respectively. However, in 1962 the ewes receiving a maintenance ration had 5.58 per cent more lambs, which supports the results of Menzies et al. (1963).

Chi Square tests indicated a nonsignificant difference in lambing percentages for ewes on the two different preflushing rations for all three years.

Haepe (1899), Darlow and Hawkins (1933), McKenzie and Phillips (1933), Clark (1934), Rice and Andrews (1953), and

Table 4. Lambing performance of the ewes fed two different preflushing rations (1962).

Ration	Single birth	Twins	Total lambs	Total ewes	Lambing per cent
Low energy	109	84	193	161	119.87
Maintenance	110	96	206	165	125.45
Total	219	180	399	326	122.39

McAdams and Coopersmith (1963) were of the opinion that flushing their ewes will generally cause beneficial effects, but that the results may not be beneficial in the case of ewes showing a high degree of condition prior to flushing.

Effect of Flushing Ewes on Weight Gain, Lambing Percentage, and on Some Other Traits

The general practice of feeding ewes well so they are gaining weight at the time of the breeding season is aimed at increasing lambing percentages, earlier breeding, and the production of larger thriftier lambs.

Table 5. Average ewe gains during the flushing period--40 days (1959).

Ration	Flushing gain ($\bar{x}$ lbs.)
1	14.95
2	16.59
3	20.31

Available evidence indicates that flushed ewes may come in heat earlier, have higher ovulation rates, are more likely to

ovulate two or more ova, and have a higher conception rate. The results of flushing gain for the four years 1959-1962 during the 40-day trial are shown in Tables 5, 6, 7, and 8.

Table 6. Average ewe gains during the flushing period--40 days (1960).

Ration	Flushing gain (X lbs.)
1	21.29
2	19.69
3	11.81
4	7.62
5	17.36
6	13.42

In 1959 there were only three flushing rations, but in subsequent years there were six flushing rations. At the end of the 17th day of preflushing, an equal number of ewes from each preflushed lot was placed in each of six flushing treatment lots and fed the flushing ration for 40 days. In 1959 the ewes in lot one received rye pasture and/or chopped green cereal crops. In addition to rye pasture, an average of 131 pounds of silage was fed each ewe during the flushing period. The ewes in lot two received a ration of three-fourths pound whole sorghum grain, one and one-fourth pounds alfalfa hay and free choice sorghum silage. The ewes in the third group grazed on pasture of buffalo grass.

Beginning in the spring of 1960 the ewes in the first group were fed three-fourths pound whole wheat, one and one-fourth

Table 7. Average ewe gains during the flushing period--40 days (1961).

Ration	Flushing gain ($\bar{x}$ lbs.)
1	17.54
2	9.68
3	8.28
4	8.14
5	11.27
6	10.40

pounds of alfalfa hay, and free choice sorghum silage in dry lot. The second group received three-fourths pound whole sorghum grain, one and one-fourth pounds of alfalfa hay and free choice sorghum silage in dry lot.

Table 8. Average ewe gains during the flushing period--40 days (1962).

Ration	Flushing gain ($\bar{x}$ lbs.)
1	11.15
2	13.12
3	9.23
4	8.50
5	9.32
6	9.55

The third group of ewes grazed a cereal crop pasture and received one-fourth pound of whole sorghum grain per head daily. The ewes in lot four were allowed to graze a cereal crop pasture

Table 9. Lambing percentages for ewes fed different flushing rations--40 days (1959)

Ration	Single birth	Twins	Total lambs	Total ewes	Lambing percentage
1	42	6	48	46	106.52
2	49	-	49	50	98.00
3	36	28	64	51	125.49
Total	127	34	161	147	110.20

and received no supplemental feed.

Those in lot five grazed a buffalo grass pasture and each received one-half pound of sorghum grain each day, and the ewes

Table 10. Lambing percentage of ewes fed different flushing rations--40 days (1960).

Ration	Single birth	Twins	Total lambs	Total ewes	Lambing percentage
1	48	12	60	58	103.45
2	50	14	64	58	110.34
3	38	32	70	58	120.69
4	47	12	59	58	101.72
5	50	14	64	59	108.47
6	47	20	67	59	113.56
Total	280	104	384	350	109.71

in lot six grazed a buffalo grass pasture.

The lambing percentages for ewes on different flushing rations are shown in Tables 9, 10, 11, and 12.

Table 11. Lambing percentage of ewes fed different flushing rations--40 days (1961).

Ration	Single birth	Twins	Total lambs	Total ewes	Lambing percentage
1	39	28	67	58	115.52
2	50	12	62	59	105.08
3	31	36	67	56	119.64
4	34	34	68	56	121.42
5	45	16	61	57	107.02
6	43	24	67	57	115.54
Total	242	150	392	343	114.28

Table 12. Lambing percentage of ewes fed different flushing rations--40 days (1962).

Ration	Single birth	Twins	Total lambs	Total ewes	Lambing percentage
1	46	14	60	56	107.14
2	41	20	61	54	112.96
3	25	58	83	56	148.21
4	27	44	71	54	131.48
5	44	14	58	54	107.41
6	35	30	65	51	127.45
Total	218	180	398	325	122.46

Ewes in the third lot which grazed on a good buffalo grass pasture during the flushing period of 40 days gained more and had the largest lambing percentage in the year 1959. In 1960 the

ewes in lot three, which grazed on cereal pasture and received one-half pound of whole sorghum grain, gained only 11.81 pounds compared with ewes in lot one which received three-fourths pound whole wheat, one and one-fourth pounds of alfalfa hay, and free choice sorghum silage in dry lot and gained 21.29 pounds. However, the ewes in lot three still had the largest lamb crop percentage. In the year 1961, the ewes in the fourth group only grazed a cereal crop pasture and gained the least by the end of the flushing period but produced more lambs than ewes in any other group. The ewes in lot three gained .14 pounds more than the ewes in lot four, and 36 per cent of them produced twins, whereas only 34 per cent of the ewes in the fourth group produced twins. However, ewes in lot four produced a lamb crop of 121.42 per cent compared to 119.64 per cent for the ewes in lot three. The difference was statistically nonsignificant. In the year 1962, ewes in lot three again had the largest lamb crop but gained only 9.23 pounds during the flushing period compared with ewes in lot two which gained an average of 13.12 pounds. Ewes in lot three, for the three years 1960 to 1962, which grazed on cereal crop pasture and supplemented with one-fourth pound of sorghum grain during the 40-day flushing period, had the largest lambing percentage. These results were in agreement with those reported by Miller (1942), Kammlade and Kammlade (1955), Morrison (1959), and Menzies *et al*. (1963).

The period of flushing in this experiment was for 40 days, which was longer than that recommended by Noot (1950), Gerring (1954), Hulet *et al*. (1962), and Wickersham (1963). Kammlade

and Kammlade (1955), Morrison (1959), Miller (1942), Gerring (1954), and Wickersham (1963) found that flushing ewes causes them to gain weight and produce a higher percentage of lambs. The correlation coefficient between group average flushing gain and average lambing percentage in this experiment was .30 (d.f. 19), which was a sizeable correlation value even though it was statistically nonsignificant. The finding was in agreement with Campbell et al. (1959), who found that flushing range ewes during breeding slightly increased the percentage of lamb crop.

The results also indicated that as the age of the ewes advanced, there was a decline in gain due to flushing with the same ration. However, age and year effects were confounded, and it was impossible to separate the effects caused by age of the ewe and those due to yearly fluctuations in environmental conditions. These results could indicate that there was little growth in the ewe as age advanced, indicating that catabolism possibly dominated anabolism. In all years, in the group which had the largest lamb crop, percentagewise, the birth weights of the lambs were significantly lower because of the increased rate of multiple births, except for the third year.

In the first year the lambing percentage was 110.20, and in subsequent years the percentages were 109.71, 114.28, and 122.46, respectively, in the second, third, and fourth years. A large part of this increase, maybe all of it, was undoubtedly due to the natural tendency for ewes to have more sets of twins as age increases. As the age of the ewes advanced the number of single

births decreased, whereas the number of twins and lambing percentages increased. This trend was in agreement with the findings of Marshall and Potts (1921), Campbell (1959), and Gerring (1954), who confidently expected 130 per cent of lamb crop from five year old ewes, and the results of this experiment showed 122.46 per cent with three and four year ewes.

There was a nonsignificant correlation coefficient between flushing gain and date of lambing (the number of days from the date the ram was turned in with the ewes until the ewe lambed). This disagreed with the statements of Kammlade and Kammlade (1955), Morrison (1959), and Dehoach and Williams (1957), but was in agreement with the findings of Menzies et al. (1963).

No close association was observed between gain from flushing and birth weight of lambs, which supported the findings of Menzies et al. (1963).

The correlation between the birth weight of the lambs and earliness of lambing was nonsignificant the first year, but for the second, third, and fourth years the statistically significant correlations were .22 (N = 334), .20 (N = 369), and .24 (N = 348), respectively. No significant association was observed between earliness of lambing and fleece weight of the ewe.

From these results, it was concluded that flushing can be done most economically with good cereal crop pasture. The birth weights of twins were significantly lower than those for singles. Flushing affected the amount of weight gained by the ewes much less as age of the ewes advanced. There were nonsignificant correlation coefficients between flushing gain and lambing

percentage, between flushing gain and earliness of lambing (year to year ranging from -.07 to .11), and between flushing gain and birth weight of lambs (ranging from -.02 to .10). The association between earliness of lambing and fleece weight of the ewe was also statistically nonsignificant, with year to year correlations ranging from -.05 to .10.

Effects of Prelambing Rations

As has been reviewed in the literature, the ewe during pregnancy has to maintain herself and also should supply nourishment for the growing fetus to get larger and healthier lambs.

The ewes used in the flushing ration were divided in 1959 and 1960 into three groups for six weeks. In the first group the ewes were grazed on good buffalo grass pasture and received one-fourth pound sorghum grain per ewe daily, while the ewes in the second group were grazed on lush rye pasture and received one-fourth pound of sorghum grain per ewe daily. Ewes in the third group grazed a good buffalo grass pasture and were fed one-fourth pound of 41 per cent protein soyabean oil meal pellets per ewe daily. The results of this experiment are shown in Table 13.

The analysis of variance of the prelambing data indicated a highly significant ($p < .01$) difference in lamb birth weight caused by different prelambing rations.

Supplemental feeding of ewes during the last six weeks of pregnancy in this experiment was in agreement with the statements of Morrison (1959), Thompson and Fraser (1939), Wallace

Table 13. Analysis of variance in lamb birth weights as affected by different ewe prelambing rations for 1959 and 1960.

Source of variance	d.f.	SS.	M.S.
Total	405	758.72	1.87
Years	1	1.13	1.31
Treatment within year	4	33.85	8.46**
Within treatment within year	400	723.73	1.80

**($p < 0.01$).

(1948a) and Wallace (1948b), Weir and Albaugh (1954), and Dehoach and Williams (1957), who recommended feeding ewes with higher level of nutrition, especially during the latter part of pregnancy.

Effect of "Creep-Feeding" on the Market Age of Lambs

Creep-feeding the suckling lambs attempting to obtain maximum gains so they will reach market weight at an early age is a common practice among lamb producers. Since market weight was essentially constant, 95 pounds, a comparison of market age is a comparison of average daily gains (excluding the relatively small variation in birth weights).

The results of market ages of lambs as affected by different creep-feeding treatments are given in Tables 14 and 15.

In 1959 the ewes and lambs were divided into three groups. The first group of ewes and lambs was grazed on rye pasture, and the lambs had access to a creep-ration of whole sorghum grain

Table 14. Market age of lambs as affected by different creep-rations.

Ration	Market age in days
1	176.66
2	165.80
3	165.29

and alfalfa hay. Ewes and lambs in the second group grazed rye pasture and no creep was provided to the lambs. Ewes in the third lot were fed a daily ration of one pound of whole sorghum grain, one to one and one-fourth pounds of alfalfa hay, and all the sorghum silage they would consume. The lambs also had access to creep of whole sorghum grain and alfalfa hay. Beginning with the 1960-61 lamb crop, the ewes and lambs were divided into six groups, and the ration fed to four groups of ewes (those in lots 1, 2, 5, and 6) consisted of sorghum silage, one pound of whole sorghum grain, and one and one-fourth pounds of alfalfa hay.

Table 15. Market age of lambs as affected by different creep-rations.

Ration	Market age in days
1	170.50
2	160.17
3	157.25
4	165.00
5	172.87
6	158.48

The third group was on rye pasture when it was available, and when not on rye, their ration was the same as lots 1, 2, 5, and 6. Ewes in the fourth group were fed sorghum silage, one pound of whole sorghum grain, and one and one-fourth pounds of dehydrated alfalfa hay. The six lamb creep-rations were respectively as follows: sorghum grain and alfalfa hay; rolled barley and pelleted alfalfa hay; sorghum grain and alfalfa hay; sorghum grain, dehydrated alfalfa pellets, and alfalfa hay; same as lot four; and a pelleted mixture of 45 per cent sorghum grain and 55 per cent alfalfa hay.

The average market age of lambs varied between 165.29 days in the third group to 177.66 days in the first group during 1959. In 1960 the lambs in the third group averaged 157.25 days, whereas those in the fifth group averaged 172.87. Lambs which had access to a creep ration of sorghum grain and alfalfa hay reached market weight 12.34 days earlier in 1959 and 15.62 days in 1960. Harper (1930), Jordan and Gates (1961), Lewis (1964), Bennion (1940), Miller (1939), Weir and Albaugh (1954), Williams (1935), Dyer and Weaver (1941), Garrigus (1951), and McDonald (1950) recommended corn as one of the ingredients of a creep ration, but in this experiment sorghum grain was used as a creep ration with satisfactory results.

In 1959 lambs in the second group which received no creep ration but grazed only on rye pasture along with their mothers reached market age at 165.80 days, which is very close to lot three, and this result supports the findings of Harper (1930), Grissom and Newell (1952).

From these findings it is concluded that it is not economical from a practical point of view to creep-feed lambs when good pasture is available.

Effect of Vaccination for Enterotoxemia on Daily Gain to Sale Date and on Market Weight of Lambs

It is an established fact that lambs doing the best on their dam's milk, lush pastures, or if the ration is suddenly changed and large quantities of rich feeds are provided, suffer from overeating disease. Lambs are generally vaccinated to prevent the disease.

In 1959 half of the lambs in each group were given 3 cc. of Cl. P. enterotoxin containing a minimum of 4,500 antitoxin units when they were 10 to 48 days of age. Bacterin was later given these same lambs when the youngest was two months old.

Table 16. Analysis of variance in market weights for vaccinated versus nonvaccinated lambs.

Source of variation	d.f.	SS.	M.S.
Total	130	2505.21	19.270
Treatment	1	13.23	13.23^{ns}
Within treatment	129	2491.98	19.317

^{ns}Nonsignificant

The results from this experiment, shown in Tables 16 and 17, indicated there was no advantage in vaccinating the lambs for enterotoxemia as far as average daily gain from birth to sale date and market weights were concerned. Bell and Erhart (1953)

also found only a slight difference in performance of vaccinated and nonvaccinated feeder lambs. Menzies and Erhart (1964) found

Table 17. Analysis of variance in average daily gains to sale date for vaccinated versus nonvaccinated lambs.

Source of variation	d.f.	SS.	M.S.
Total	130	1.049	.009
Treatment	1	.011	.011^{ns}
Within treatment	129	1.048	.008

^{ns}Nonsignificant

the difference in daily gain of only 0.01 pound between vaccinated and nonvaccinated lambs. From the economical point of view it did not pay to vaccinate; especially since one lamb died from a reaction when the bacterin was given, and one antitoxin treated lamb died about one month after treatment.

SUMMARY

In 1959 investigations concerning milk-fat lamb production practices for western Kansas were initiated with 151 ewes at the Colby branch of the Kansas Agricultural Experimental Station by Professor Carl S. Menzies and Mr. Evans E. Banbury. In 1960, 200 additional ewes were purchased and added to the flock. The purpose of this experiment was to determine the effects of preflushing ewes on weight loss and lambing performance, effects of flushing ewes on weight gain, lambing percentages, earliness of lambing, birth weight of lambs and fleece weight, effect of prelambing rations on lamb birth weight, effect of feeding on market

age of lambs, and effect of vaccination on marketing weight and daily gain to sale date.

The results of this experiment involving 351 ewes from the year 1959 to 1962 in general did not support some of the previous established theories.

A significant difference in lambing percentages was not observed between groups of ewes on two different preflushing rations for the years 1960 and 1961.

As age of the ewes advanced, the effect of flushing decreased, as far as weight gain was concerned. Also, as the ewes became older there was an increased tendency for them to have more twins and higher lambing percentages. Statistical analysis did not show a significant correlation coefficient between flushing gain and lambing percentage, .30 (N = 19); significantly lower birth weight of twin lambs than singles was observed. Nonsignificant correlations between flushing gain and earliness of lambing (year to year ranged from -.7 to .11), between flushing gain and birth weight of lambs (-.02 to .10), and between earliness of lambing and fleece weight (year to year correlations ranging from -.05 to .10).

Analysis of variance in the different prelambing rations indicated a highly significant difference between the prelambing rations and lamb birth weights ($p < 0.01$).

The experiment indicated that lambs receiving a creep-ration of sorghum grain and alfalfa hay reached market weight 12.34 days and 15.62 days earlier in 1959 and 1960, respectively.

The results of vaccinating lambs for enterotoxemia did not indicate any advantage for average daily gain.

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MILK-FAT LAMB PRODUCTION PRACTICES FOR WESTERN KANSAS

by

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In 1959 investigation of milk-fat lamb production practices for western Kansas was initiated with 151 ewes at the Colby Branch of the Kansas Agricultural Experimental Station. In 1960, 200 additional ewes were purchased. The purpose of this experiment was to determine the effects of preflushing the ewes on weight loss and lambing performance, effect of flushing ewes on weight gain, lambing percentages, earliness of lambing, lamb birth weight and fleece weight, and the effect of different prelambing rations on birth weight of lambs. Also studied were the effects of creep-feeding on market age of the lambs, and effect of vaccination for enterotoxemia on marketing weight and daily gain to sale date of lambs. The results of the first four years, 1959 to 1962, involving 351 ewes of this experiment are reported.

Preflushing ewes did not cause a significant difference in lambing percentages. Flushing failed to cause older ewes to gain weight, but there was an increased tendency for them to have twins, which resulted in larger lambing percentages. The nonsignificant correlation coefficient between average group flushing gain and average group lambing percentages was .30 (d.f. = 19). Twin lambs had significantly smaller birth weights than singles.

Nonsignificant correlation coefficients between flushing gain and earliness of lambing ranged from -.7 to .11 (from year to year), between flushing gain and birth weight of lambs ranged from -.02 to .10, and between earliness of lambing and fleece weight the year to year correlations ranged from -.05 to .10.

The analysis of variance in the different prelambing rations

indicated a significant difference between the effects of the prelambing rations on lamb birth weights ($p < 0.01$). Lambs receiving a creep ration of sorghum grain and alfalfa hay reached market weight earlier than those on any other creep ration. There was no advantage in average daily gain from vaccinating lambs for enterotoxemia.